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Wing-like Appendages on the Petioles of *Liriophyllum populoides*  
Lesq. and *Liriodendron alatum* Newb., with De-  
scription of the Latter.

BY ARTHUR HOLLICK.

(PLATES 220 AND 221.)

The specimens upon which this paper is based were recently found while re-arranging some material in the geological museum of Columbia College. One of them had been recognized by the late Professor J. S. Newberry as a new species, and upon the specimen of *Liriodendron* he had attached the manuscript name which is here retained. The *Liriophyllum* was merely labeled under its generic name. The reason for not having named it specifically will be apparent when the discussion in regard to it is reached. I have brought them together in this paper for the reason that, although representing different geologic horizons in the Cretaceous formation, they are biologically closely related, and also because we have in these two species the first record in either genus of the peculiar appendages to the petioles to which I wish to call particular attention.

LIRIODENDRON ALATUM NEWB. mss.

(Plate 220.)

Leaves 4-5 inches long by 3-4 inches wide, oblong or ovoid in outline, rounded or somewhat cordate at base; deeply emarginate at apex, lobed or constricted at sides, or merely with wavy

margins; petioles long, stout and conspicuously winged; nervation characteristic of the genus, consisting of two sets of parallel secondaries, one strong, connecting near the margins in festoons, the other weaker and intermediate with the former.

Laramie group, Walsenberg, Colo. Collected by Mr. J. Miligan under the direction of Mr. R. C. Hills.

The genus *Liriodendron* is represented in our living flora by a single species, *L. Tulipifera* L., our well known tulip tree, and a doubtful variety, *L. Tulipifera Chinense* Hemsl. from eastern Asia.\*

In the past, however, ranging from middle Cretaceous through the Tertiary, we find a great number of species referable to the genus and its immediate ancestors, the leaves of which indicate diversities in form equal to those of the oaks of to-day and with a geographic range equally extensive.

An enumeration of all the described forms is not necessary here, as several papers upon the subject have been already written, prominent among which may be mentioned those by Dr. J. S. Newberry† and Mr. Theo. Holm.‡ Incidental comments may also be found in the works of Heer, Massalongo, Lesquereux, Ward and others.

If we examine the fossil species described under or referred to the genus we find the evolution of the leaf form to be exceedingly interesting and significant. The earliest ones (*Liriodendropsis simplex* Newb. mss., *Phyllites obcordatus* Heer, etc.) have little more than the characteristic emarginate apex by which to identify them with the genus. Others are slightly lobed or merely constricted at the sides (*L. primævum* Newb., *L. Meekii* Heer, etc.). Yet others are conspicuously lobed (*L. giganteum* Lesq., *L. acuminatum* Lesq., etc.), while the Tertiary species (*L. Procaccinii* Ung., *L. Helveticum* Fisch., etc.) are hardly to be distinguished from the living one. Attention may also be called, incidentally, to the fact that there was a constant increase in the size of the leaves during

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\* 1. "Description of some new Phanerogamia collected by Dr. Shearer, at Kiu-kiang, China," S. Le M. Moore, Journ. Bot. 13: 225 (1875).

2. "Enumeration of all the plants known from China proper, Formosa, Hainan, Corea, etc." F. B. Forbes and W. B. Hemsley, Journ. Linn. Soc. 23: 25 (1886).

† "The Ancestors of the Tulip-Tree," Bull. Torr. Club, 14: 1-7. pl. 61, 62 (1887).

‡ "Notes on the Leaves of *Liriodendron*," Proc. U. S. Nat. Mus. 13: 15-35. pl. 4-9 (1890).

the period of greatest development of the genus, in cretaceous times. The particular species with which this paper has to do is of importance for the reason that only one other *Liriodendron*, and that an imperfect specimen, has been described from the Laramie group (*L. Laramiense* Ward, Bull. No. 37, U. S. Geol. Surv. 102, *pl.* 48, *f.* 2), and also because our species possesses the unique characteristic of a winged petiole. Leaving this feature to be discussed further on, attention is now called to the significance of the leaf forms.

From the standpoint of the evolutionist the development of the individual is the epitome of the development of the type, so that we ought to find some traces of the ancestry of the genus in the successive leaf development of our living tulip tree. This aspect of the subject has been commented upon by several of the authors previously mentioned, but their works were prepared previous to the issue of Lesquereux's posthumous "Flora of the Dakota Group" (Monog. No. 17, U. S. Geol. Surv., 1892), and the great development of the genus there brought out was not known to the writers; neither, of course, was the species which is described in this paper, so that many points of significance were missed by them.

During the present year I made a series of observations upon and collected a number of specimens of leaves from seedlings, saplings, shoots from old stumps, and the branches of mature trees. They, of course, vary exceedingly, but by regarding the series as a whole it will be seen that there is a most striking parallelism between the entire or merely undulate margins of the leaves from the seedlings and young shoots and the earliest fossil forms, represented by *L. simplex*, *L. primævum*, etc., while it is in the leaves of the more mature branches that the lobing becomes of sufficient prominence to compare them with later forms like *L. giganteum*, *L. acuminatum*, etc.

The significance of the wing-like appendages to the petiole may now be considered. Similar appendages have been noted in other genera, and we are indebted to Prof. Lester F. Ward for having presented the case of *Platanus* ("Palæontologic History of the Genus *Platanus*," Proc. U. S. Nat. Mus. 11: 39-42, *pl.* 17-22; "Origin of the Plane-Trees," Am. Nat. 24: 797-810, *pl.* 28), and

for showing that these appendages apparently represent former basilar lobes of the leaf, which have become detached and gradually crowded down the petiole until they finally exist as mere stipules at the bases of the petioles or on the branches adjacent. The living *Platanus occidentalis* L. often bears leaves on its young shoots which show basilar expansions similar to fossil ancestral forms, and the conspicuous foliaceous stipules at the bases of the petioles are familiar objects to us all. It seems reasonable, therefore, to attribute a similar origin to the conspicuous but fugacious stipules on the young saplings and shoots of *Liriodendron Tulipifera*, and this view is of course greatly strengthened by the discovery of the fossil species now under consideration. It is also of significance to note that the appendages to the petiole, as represented for the first time in *L. alatum*, made their appearance in the genus during the Laramie period, a time intermediate between the era of greatest lobation of the leaves in the middle Cretaceous and that of the development of a modern type in the Tertiary, in which the former excessive lobation has become greatly modified. This consideration of the subject logically leads to a discussion of the origin and significance of stipules in general, and raises the question whether they may all have had a similar origin. Such a question can not be decided, or even discussed at any length, until more data than are now in our possession have been accumulated, and the facts examined from the standpoint here indicated.

#### LIRIOPHYLLUM Lesq.

The genus *Liriophyllum* was founded by Lesquereux (Hayden's Rept. U. S. Geol. & Geog. Surv. 1876, 482) to include certain leaves evidently closely allied to *Liriodendron*. Under it he subsequently described three species of leaves and one fruit.\*

A comparison of these leaves with the specimen now before us

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\* *L. Beckwithii* Lesq. Cret. and Tert. Fl. (1883) 76. *pl.* 10, *f.* 1.

*L. populoides* Lesq. l. c. 76. *pl.* 11, *f.* 1, 2.

*L. obcordatum* Lesq. l. c. 77.

*Carpites liriophylli* ? Lesq. l. c. 77. *pl.* 11, *f.* 5.

*L. obcordatum* was not figured at the time of its original description, but it may be found in Lesquereux' "Posthumous Flora of the Dakota Group" (Monog. 17: U. S. Geol. Surv. (1892) 210. *pl.* 28, *f.* 7).

will at once show that the latter is apparently identical with *L. populoides*, which supposition is supported by the fact that they were both found in the same geological horizon (Dakota group) near Morrison, Colorado. The one difference between them is the winged petiole which is such a prominent characteristic in our specimen. Its absence in Lesquereux' specimens is doubtless to be accounted for by the imperfection of his material, but a close examination of his *fig. 2* will show that there is a widening of the petiole where it is broken off, which evidently indicates the existence of similar appendages.

Finally I would call attention to a point which may have considerable significance in relation to the theory of the origin of stipules previously outlined. The specimens which are the subject of our illustration apparently represent a large mature leaf and a smaller immature one. In the mature leaf there is a distance of about three-eighths of an inch between the base of the leaf blade and the beginning of the winged appendages, while in the young leaf they are in juxtaposition, conditions which are to be expected if our theory of their origin is the correct one.

NOTE.—Since writing the above Dr. Britton has called my attention to the following, which is of peculiar significance in this connection:

The late Dr. Thomas Morong, in his manuscript of "The Smilacæ of North and Central America," in speaking of the species which climb by means of tendrils growing from stipular wings on each side of the petiole, uses these words in a foot note: "De Candolle regards this appendage as more in the nature of a modified leaf segment or leaflet than a stipule, but it seems to me that a stipule is nothing else than a leaflet at the base of a petiole."\*

## Two Species of *Oxalis*.

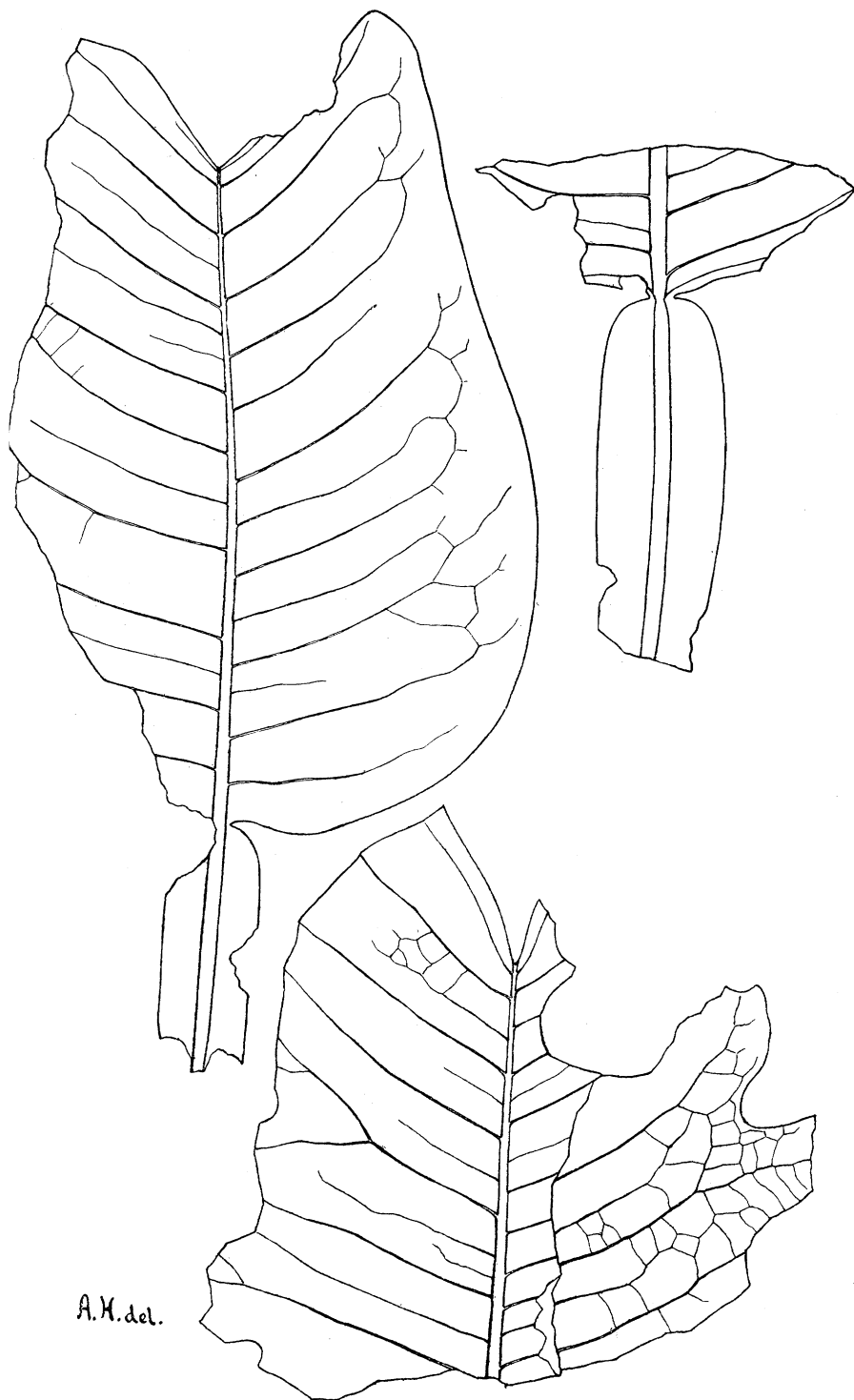
BY JOHN K. SMALL.

(PLATES 222 AND 223.)

For several seasons during my excursions through portions of the Southern States I have met with a peculiar little *Oxalis*,

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\* See Bull. Torr. Club, 21: 419.



LIRIODENDRON ALATUM NEWB.



LIRIOPHYLLUM POPULOIDES LESQ.